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FOREWORD

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This is a serial publication containing selected translations on the fuel, electric power, mining, metallurgical, and construction materials industries in Eastern Europe.

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CZECHOSLOVAKIA

CONSIDERATIONS OF THE BALANCE OF COAL RESERVES IN THE OSTRAVA-KARVINA COAL DISTRICT

[Following is the translation of an article by Eng Jan Polan in Uhli (Coal), Vol III, No 1, Prague, 1961, pages 6-9.]

The Ostrava-Karvina Coal District is our greatest natural base for ensuring the development of the mining, chemical, and power industries. Black coal and metallurgical coke for metallurgy is exported not only to the friendly nations of the peaceful camp but also to the capitalist states. It is, therefore, necessary to pay special attention to the problem of the condition and movement of the known coal reserves within the mining areas of the district.

Contemporary state of coal reserves.

The common term "reserves," used in the geological sense, is indefinite to a certain extent. Even though we are collecting data dealing with reserves from the individual mining fields, and then add, multiply, and divide the data, we only slightly consider the real significance of the resulting numbers.

The reserves are calculated on the basis of already realized mining works and also on the basis of boring work. In the first case the determined data are quite exact; in the second case they are usually exaggerated. Finally, we calculate the resources on the basis of analogy from the neighboring conditions of the area studied a part of it, or the whole mining field. The findings based on the executed mining works are relatively few; therefore, we usually lean on the results and analyses of boring research. Even here one finds, in view of the expensive type of work, a differentiation between the real conditions of the coal reserves and an evaluation fortified with written, graphic, and material documentation. Because of other pressing tasks, nobody, unfortunately, concerns himself with a retrospective comparison of the results after the investigated field has been mined dry. From the economic point of view, such work would certainly be very interesting and informative.

Mining undertakings used to be a question of the risks involved. One was interested in the profit of the expended investment. This risk has been minimized through geological investigation and research, but has also been carried over to investitive activity; on this activity depends the real amount of the deter-

mined reserves, their division into categories, and their qualitative evaluation. As has already been mentioned, coal investigation (research) must deduct conclusions about the condition of resources from mere "point" surveys (of the yield of the coal core). On them is dependent the planning and project preparation of the construction of new mines or the reconstruction of existing mines, and thus the economic distribution of investments within a given district.

The resources are divided, on the basis of the results of the investigative activity, into different categories; however, in the course of planning conflicts of different magnitudes developed according to conditions in the individual investment units.

If we look at the coal resources in the Ostrava-Karvina Coal District, we realize that in the directives of the Commission for the Classification of the Resources of Mineral Raw Materials, issued in a governmental ruling, not one of the mines in the Ostrava-Karvina Coal District has a prescribed ratio of resources of the category $A:B:C_1$ given 10:40:50: If we compare this fact with conditions in 1954, when a computation of all mines was executed and approved, we see how many plants, i.e., enterprises have received "as a dowry," together with the expended investment means, also resources in the prescribed ratios.

According to the directive of the Central Geologic Institute No 180/57 U.1., by 1 January 1960 more evidence of the condition and movement of the resources in individual mines was produced. After the processing of statistical reports from the individual mines, it is possible to form certain conclusions.

Except in the case of the large mines CSA, Fucik, Ludvik, Stachanov, and Hlubina, no prescribed ratio of the categories of the reserves is reached within the district.

The mines mentioned have not executed the required transfer of resources since 1954. In the case of individual investment actions (for reconstruction) which required this ratio in the pertinent planned level or mining field, the ratio was, of course, established through investigation and research.

If we consider as the most advantageous ratio of resources $ABC_1:C_2$ equals 50:50, then this condition is met only by one-half of the plants. Similarly, only one half of the mines satisfies the resource ratio $AB:C_1$. These data are given in more detail in Table 2.

If we compare the condition and the movement of resources between 1 January 1959, towards which the calculations of the resources were directed, and 1 January 1960, we notice a fall in the resources. Table 3 gives a detailed account of the reasons for and the level of the fall of the resources investigated.

Table 1 - 2

NATIONAL ENTERPRISE	1954 / 1960	$\frac{A+B}{C_1}$	$\frac{A+B+C_1}{C_2}$
Gottwald	—	30	25
1 May	—	50	66
ČSA	—	72	93
Doubrava	—	18	70
Zápotocký	—	27	43
Dukla	—	66	36
Žofie	—	59	91
Čs. pionýr	—	52	42
J. Fučík	—	36	37
Ludvík	—	41	36
Suchá Stonava	—	44	91
Stalin Stonava	—	30	48
P. Bezruč	—	76	44
P. Cingr	—	14	53
Trojice	—	59	59
V. únor	—	54	24
E. Urx	—	62	97
Stachanov	—	67	54
J. Šverma	—	40	86
Zárubek	—	51	22
Hlubina	—	45	67
OSTRAVA-KARVINA DISTRICT	—	41	63

Table 3

Difference in the state of resources in 1959 and 1960	79,657 kt	100%
After recalculation to the new condition	40,759 kt	51%
through mining	22,381 kt	28%
through losses during mining	817 kt	1%
through confirmed depreciation	2,829 kt	3.5%
through transfer to limited resources (balance)	5,888 kt	7.5%
through transfer to non-balance resources	6,983 kt	9%

On the other hand, during the year the Mining Geologic Service has reported an increase in resources of 30,076 kt; this is 24.7% higher than the loss caused by mining.

If we concentrate more closely on the condition and movement of the free balance of resources, i.e., mining resources (after the subtraction of protective pillars and otherwise limited tons of coal), we can compare resource ratios in the three main sectors of the mines:

a) in the area of the last mining level,

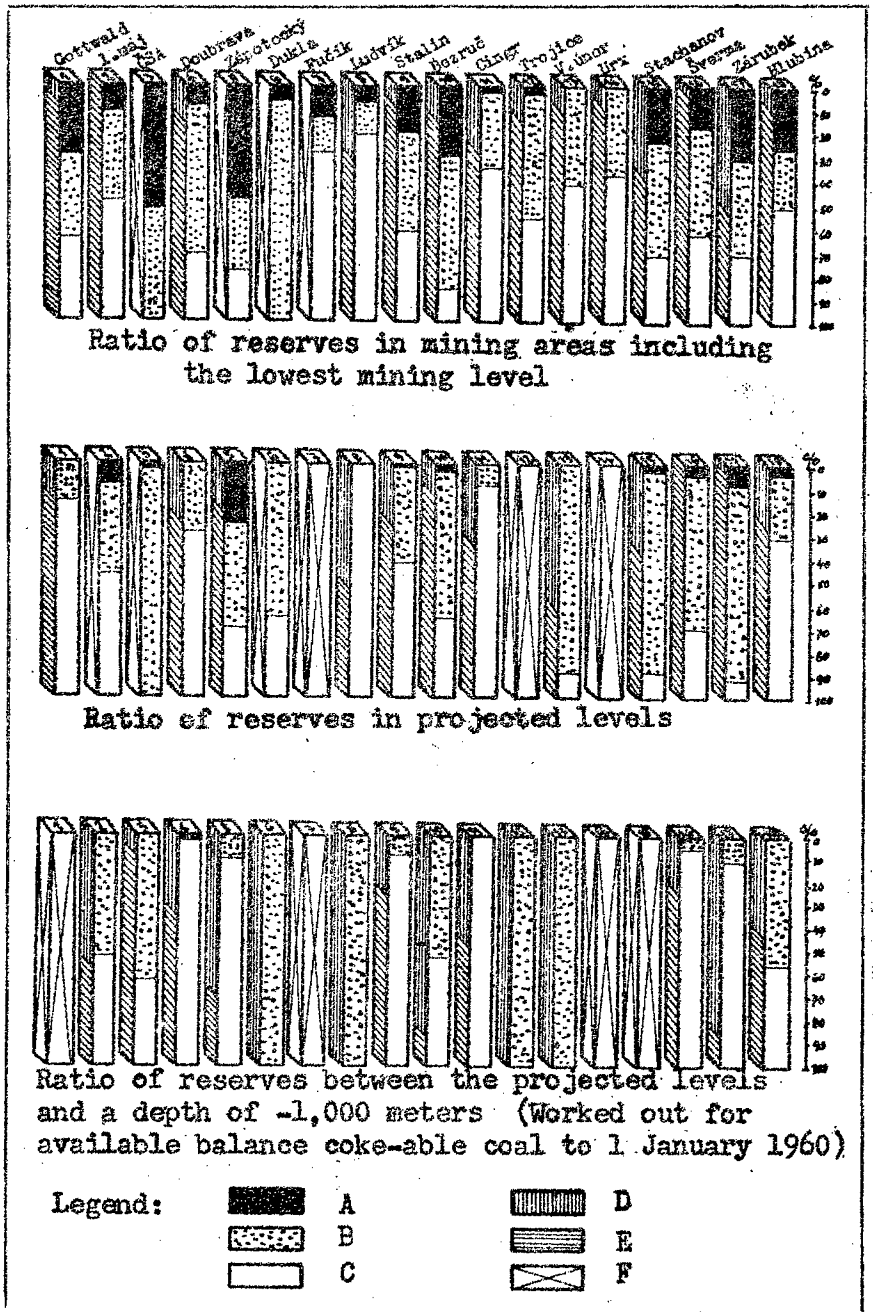
b) in the foreseen level,

c) in the remaining area under the foreseen level to a depth of 1,000 meters.

For a better general view, see the graph at the end of the article.

At first glance it is obvious that we have a dwindling percentage of resources in category A. A question arises as to whether this category should be at all in the ratio of the Ostrava-Karvina District and if the "Rules of the transfer of deposits" should not be changed so that the relevant ratio for the new fields would be $B:C_1$ equals 50:50. Considerable tectonic divisions and depths of the seam position, which do not occur in any other of our coal districts, and fluctuating strength and quality, which does not guarantee certain results on the basis of mere boring work,

Graph [Table 4]



Ratio of reserves in mining areas including the lowest mining level

Ratio of reserves in projected levels

Ratio of reserves between the projected levels and a depth of -1,000 meters (Worked out for available balance coke-able coal to 1 January 1960)

Legend: A - reserves of category A
B - Reserves of category B
C - reserves of category C_1
D - reserves of category C_2
E - reserves of category ABC_1
F - without reserve

were discussed above. Category A should , therefore, be always supplemented with definite mining work whose claims do not lie level with their economic effect.

If the boring net, established for the Ostrava-Karvina conditions at the range of 1,000 meters for stable seams and at 500 meters for relatively stable seams, should be the only basis for the calculations of the resources of category A, it would require an increase in the net's density by at least one half, as we can judge from today's experience and the degree of risk which we can allow for in our research. We can, therefore, conclude that the requirement of a certain amount of resources of category A is not profitable for the Ostrava-Karvina Coal District from the economic and other points of view and that it demands revision.

Limited resources.

By "limited resources" we understand that part of balanced and non-balanced resources which is not minable, not because of geological, technical, or technological conditions, but because of the safety of the miners or because of the safety of the mining and work area. Included are:

a) protective pillars around the main and the ventilation shafts,

b) shoots, passages, and galleries,

c) protective pillars against breakthroughs of water or gas,

d) supports under surface projects.

A separate category is the resource in currently abandoned or inaccessible seams or their older, abandoned parts (in the Ostrava-Karvina District mining has been going on for over 100 years which could be reopened after careful economic consideration. Limited resources constitute a considerable item in our district, as can be seen from Table 5.

Table 5

Frozen resources	in %
in walls around mining and ventilation shafts	15.5
in walls around shoots, passages and galleries	1.6
in protective pillars under detritus	0.4
as supports under surface objects	2.4
inaccessible resources	3.0
of total balance of resources of the Ostrava-Karvina District	22.9

If we consider that we deal with resources, supposedly within reach, which do not require practically any research, preparatory work, and beginning work or only in a very small amount, then it is worthwhile to consider the questions connected with this problem. A reason for such consideration is, for example, the fact that we have a mining shaft in the district which exists without the prescribed protective pillar and where control measurements have shown that in 15 years there has not been any excess shift in the shaft axis.

If we considered only one-quarter of the above limited and inaccessible resources, then, under today's production, these resources would be able to cover the capacity of the whole district for ten years, under at least the same costs.

Depreciated resources.

If we take the results of the work of the Commission for the Review of Coal Resources for the whole of 1959, we can form a critique which shows what amounts of the resources, according to the petitions of the plants, should be depreciated, how many petitions were processed positively, and what percentage these petitions formed in the submitted amount: (Table 6).

The reasons for the depreciation petitions were determined according to the "Principles for the determination of the mining of seams according to the results of detailed research in the Ostrava-Karvina District," which determined as temporary the main factors which can cause the deposit or a part to become unminable.

For review, Table 7 has been compiled.

Limited reserves are one of the advantageous sources of a cheaper and faster output, while depreciated and depreciable reserves are one of the loss routes, through which we sometimes lose our coal reserves because of more or less justifiable reasons. It is, therefore, up to the Commission for the economy of the Coal Reserves, attached to SOKD, to weigh the submitted petitions for depreciation, the attached documentation, and economic analyses.

Some reasons are clear at first sight, for example, the necessity for the depreciation of reserves as a consequence of mining accidents caused by unforeseen cave-ins, flooding, fire, or other occurrences which prevent forever the mining of a certain part of the deposit. Some cases, however, require reinvestigation and a searching for ways to improve the work of the technicians, for example, if the petition involves resources depreciated through incorrect procedures in mining. This includes, for example, blocking access to a part of the minable reserves through the undermining of higher placed minable seams, filling of mining works in an incorrect manner, and other cases dependent on the technical solutions of the mining procedure.

Table 6

COAL RESERVES SUBMITTED FOR DEPRECIATION		APPROVED	%
1 ČSA	1 352 660 t	398 800 t	29.5
2 J. Fučík	374 562 t	—	—
3 Bezruč	299 210 t	23 600 t	7.8
4 Hlubina	60 900 t	—	—
5 Gottwald	1 320 590 t	—	—
6 1 May.	203 293 t	—	—
7 Žofie	310 400 t	24 500 t	7.9
8 Zápotocký	423 200 t	219 700 t	51.9
9 Trojice	36 240 t	12 450 t	34.3
10 Zárubek	1 173 630 t	—	—
11 V. únor	37 100 t	5 980 t	16.1
12 Šverma	22 000 t	—	—
13 Stalin	296 751 t	257 080 t	86.6
14 Doubrava	11 500 t	—	—
15 Čs. pionýr	11 000 t	—	—
16 Dukla	126 550 t	126 550 t	100.0
17 Urx	27 910 t	—	—
18 Stachanov	84 925 t	—	—
TOTAL OSTRAVA-KARVINA DISTRICT	6 172421 t	1 068 660 t	17.3 %

Conclusion

This partial analysis from the first statistics of the data shows that in connection with the coal reserves in the C Karvina Coal District there are many problems which should be It has been shown, among other things, that in the comprehens analysis of the economy of the cooperative of the Ostrava-Kar District, we have a lot to catch up with in this area in conn with attaining a growth in labor productivity and the lowerin costs and investments. For example, the costs related to one coal exceed the gain by 8.28 Kcs, so that the district has in a deficit in 1959 of 71 millions Kcs, an amount which influen economy of the district. Therefore, it is necessary to give attention to the question of coal reserves.

Table 7

Reason for depreciation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
tectonic divisioning	5	5	3	1	2	3	/	4	/	/	3	/	1	/	/	/	/	/
above average amount of water	/	/	/	/	/	2	/	/	/	/	/	/	/	/	/	/	/	/
above average amount of ashes	3	/	/	/	1	/	2	/	/	/	/	1	1	/	/	/	/	/
disproportionate costs	2	1	1	/	/	1	/	1	1	/	/	/	/	/	/	1	/	/
obstacles in outlets	1	1	/	/	/	/	/	/	/	/	/	/	3	/	/	/	/	/
endangering of security	/	/	/	/	/	/	1	1	1	/	/	/	/	/	/	/	/	/
liquidation	/	/	/	/	/	/	/	/	/	1	/	/	/	/	/	/	/	/
others	8	6	1	1	3	2	2	/	/	1	1	3	3	2	1	/	1	2
Number of petitions	19	13	5	2	6	8	5	6	2	2	4	4	8	2	1	1	1	2

10,473

CZECHOSLOVAKIA

SUCCESS OF THE BUILDERS OF THE SUCHA-STONAVA MINE

/Following is the translation of an article by Cestmir Berka in Uhli (Coal), Vol III, No 1, Prague, 1961, pages 3-6./

This year the average daily mining production in the new mine Sucha-Stonava is planned to reach 1625 tons, and is to be even increased further. The initiative of the workers during the construction of this new mine was the reason that the first coal was extracted from the mine 17 months earlier than planned. During the celebrations of the forty-third anniversary of the Great October Socialist Revolution on 6 November 1960, the first coal from the mine was ceremonially presented to the mining enterprise and the first trucks of coal were extracted.

The newly built mine Sucha-Stonava is the first plant in the Ostrava-Karvina Mining District which has been drafted, projected, and constructed from the beginning of the period of our socialist construction. It was built "on a green pasture," and its mine field had not yet been fully explored at the time of the beginning of the project. Therefore the project, worked out by a group of workers of the Mining Projects in Ostrava under the leadership of Inz Walter Nardelli, presupposed that the construction of the mine would be difficult because the mine fields lie under or in close proximity to detritus.

The surface construction was designed in a new way, and the designers were working towards the highest possible efficiency. The basis for the design was a system which utilizes the greatest industrialization of building construction through the use of advanced elements and methods for the assembly of prefabricated units. In this, the designers were aided by a prototype of the mine which had been shortly before worked out by the mining projects in Ostrava. Otherwise it would not have been possible to meet the very close deadline.

The investment proposal had been submitted by the investor in summer 1955, and within a year the introductory project was already in the finishing stage. The location of the new plant was placed within the area of shaft PG III (unfinished shaft, terminated above the water-carrying level; it had been formerly considered for a ventilation shaft for the mine President Gottwald) between the obeces Horni Sucha, Stonava, and Albrechtice. The new mine had also been given "as dowry" in the north-western part of the mine field a completed ventilation shaft, Barbora V, near which was proposed a further ventilation shaft, Sucha-Stonava II. The surface installations of the plant were situated in the center of the mine field; the first projected levels (sixth and seventh) are located away from the center.

The total area of the mine fields is 1138 hectares. The total

resources are about 209 million tons of coal, with balance resources of about 160 million tons of coking coal. These resources are counted up to the last seam of the saddle zone, i.e., seam "Prokop." The average width of the seams in this mine is 1.79 m. An average mining capacity of 340 tons in 24 hours is expected. The main mining shaft will be equipped with a skip and cage mining installation. For air supply, we are installing new prototypes of turbo-compressors made by CKD Stalingrad (for 32,000 and 50,000 m^3/hour). We estimate the utilization of 6.5 m^3 of air per ton of coal.

In mine investment works, the introductory project mentions 52 km of horizontal and vertical mining area, a total of nearly 700,000 m^3 of excavation. The excavated material could fill a train extending from Teplice through Prague and Ostrava to Kosice. In the future, we count on subterranean stone-crushing installations for the filling, so that the stone from further excavation work will not need to be disposed of on the surface.

These selected data concerning the new mine, derived from the complex introductory project of the Mining Projects in Ostrava, certainly speak sufficiently clearly of the size of the development of the new plant and the huge tasks of its builders.

The shortening of the period of construction of the new mine, which was named Mine of the Third-year Plan (Dul treti petiletky), will bring into our national economy over 600,000 tons of coking coal. The new mine should reach, even during its first year, an average daily output of 1625 tons; in the last year of the Third Five-year Plan it will produce 5500 tons, and during the Fourth-Five Year Plan 6000 tons of coal per day. While during the first mining jobs we will use in the edges of the seams and in the neighborhood of exhausted areas only scraper machines, in later years we will substitute the newest and most advanced mechanization. Besides cutter-loaders, we are counting on an all-metal, so-called progressive reinforcement belt installation for removal of the mined material and for train connections for the transportation of miners.

On 1 January 1961 the Mine of the Third Five-year Plan has accepted the planned production tasks and has thus placed itself among the other mines of the Ostrava-Karvina Mining District.

CZECHOSLOVAKIA

RESULTS OF SHORTENED WORK WEEK IN COAL MINES

[Following is the translation of an article in Hospodarske Noviny (Agricultural News), Prague, May 1961, page 4]

In Hospodarske Noviny No 4 we published a summary outlining some of the most important results in the experiments with a shortened work week in the coal industry. Among those who achieved very good results were the coal miners of the South Moravian lignite area.

Last August the workers of the South Moravian area started an experimental operation with a shortened work week in the 01 Concern in Dubany. Based on this experience, other mines in that area also started experiments with a shortened work week.

The coal miners of the 01 Concern promised to establish an experimental operation with a shortened work week without asking for additional workers, and to compensate for the loss of working time by increasing labor productivity. The workers of some other concerns agreed to cover more than 80% of the loss of working time, and, with temporary additional help, to balance the production by the end of 1960. The results of the experimental operation in all mines showed that the workers did fulfill their obligations and that the goals set for the experimental operation with a shortened work week were exceeded. It has again been proved that thorough preparation is an inevitable necessity and a basic principle for achieving good results. The goals were not easy. For example, the obligation accepted by the South Moravian lignite miners meant that, maintaining a five day work week, the daily average coal output would be increased by more than 15%. The productivity of the shifts had to be increased by at least 12%, maintaining a further lowering of production costs.

How the Various Tasks were Fulfilled

In 1959 the miners of the South Moravian lignite mines brought to the surface an average of 85,050 metric tons of lignite a month; in the first half of last year the average monthly coal output increased to 92,650 metric tons, an increase of 8.9%, and during the experimental operation with a shortened work week the coal output increased to 96,970 metric tons a month -- which means a further increase of 4.7%. Simultaneously, the average

daily coal output also increased. Thanks to good preparation of the experimental shortening of the work week, the plan to increase the coal output, which compared to the year 1959, showed an increase of 33.8%, and compared to the actual coal output in the first half of 1960 an increase of 22.9%, could be exceeded.

Following is a schedule of the completed tasks and index of the average monthly and daily coal output:

Index		Before Experimental shortening of Work Week		After Experimental shortening of Work Week	
		1959	Jan-Jun 1960	Oct-Dec 1960	Jan-Mar 1961
Monthly Output (in metric tons)	Actual	85,050	92,651	94,564	99,379
	Percent	102.1	103.9	101.3	104.3
Daily Output	Actual	3,335	3,633	4,350	4,577
	Percent	102.1	103.9	100.2	104.1
Increase Ratio of Output	Monthly	1.00	1.09	1.11	1.17
	Daily	1.00	1.09	1.30	1.37

An important factor in the increase of the average daily coal output during the experimental shortening of the work week was the application of one of the main principles: maximum utilization of technical means in order to compensate for the loss of working time. For example, the quota of the coal output dug by the combines (continuous mining machines) and coal cutters showed an increase of more than 11.5% as compared to 1959, and presently is reaching approximately 87% of the total coal output.

The good results obtained in coal mining had, of course, an influence on the fulfillment of other production indicators, labor productivity being one of the most important among them. The goal to be reached by the workers of the South Moravian lignite mines was a very difficult one, as it was necessary simultaneously to secure the rate of increase in labor productivity which was outlined in the third Five-year Plan. How this goal was reached is shown by the following table:

The development of labor productivity in metric tons per worker:

Index (Increase Ratio)	Before Experimental shortening of Work Week		After Experimental shortening of Work Week	
	1959	Jan-Jun 1960	Oct-Dec 1960	Jan-Mar 1961
Labor Productivity	1.00	1.15	1.17 +	1.21
Monthly Earning	1.00	1.11	1.19	1.16

The + ratio includes an increase in the amount of earnings during the holidays -- additional shifts -- over plan output.

The results prove that the workers started to create the conditions for increasing labor productivity already during the preparation for the experimental operation with a shortened working time, and that because of good results obtained during the preparation they were able to increase labor productivity to such an extent as to be in a position to compensate in the highest degree by their own efforts for the loss of working time.

An increase in the coal output from surface mines, underground mines, and the total output brought about an increase in labor productivity. Due to increased mechanization in mining, better organization of work in the auxiliary operations underground and on the surface, and due to the technico-organizational measures and utilization of reserves, the output from surface mines showed an increase of 16.2%, compared to 1959, and the total output showed an increase of 23.7%.

Increase in the productivity of shifts:

Index	Before Experimental Shortening of Work Week		After Experimental Shortening of Work Week	
	1959	Jan-Jun 1960	Oct-Dec 1960	Jan-Mar '61
Achieved	26.26	30.29	30.75	31.91
Percentage of Plan Fulfilment	106.00	105.04	100.1	102.6
Increase Ratio	1.00	1.15	1.17	1.21

The increase in output and in labor productivity was reflected in the increase of the average monthly earnings. (As regards the additional voluntary shifts, here the results are partially influenced by the larger number of these shifts.) It is evident that in the courst of the experiments with shortened working time, there was an increase of average earnings, along with an increase of productivity of work. The development indicates an increased ratio of labor productivity and an increased ratio of average monthly earnings.

Following is a comparison between the average monthly earnings (per worker) and the monthly productivity of work (in metric tons per worker):

Index (In metric tons per worker during one shift)	Before Experimental Shortening of Work Week		After Experimental Shortening of Work Week	
	1959	Jan-Jun 1960	Oct-Dec 60	Jan-Mar 61
Output in Surface Mine	5,111	5,438	5,808	6,067
Output in Underground Mine	2,340	2,515	2,810	2,936
Total Output	2,038	2,188	2,458	2,587
Output during Preparation	88	90	112	118

Of great importance were the good results which had been reached in the fulfillment of the plan regarding production costs. The workers of the South moravian lignite mines have obtained nearly the best results in lowering production costs. This was evident not only in the lowered costs, but also in that the profit planned for the first quarter of 1961 was surpassed by 46.6%, which represents approximately 1.28 million Kcs [ceskoslovenskych korun] more than planned.

The results are good, first of all, because all the workers were acquainted with the tasks which were about to follow from the shortening of working time, and every collective had a clear and definite assignment which guaranteed fulfillment of the decisive tasks of the whole national project. Appropriate propaganda and explanation of the principles of the experimental shortening of the work week were responsible for the correct understanding of the whole task, especially of the principle: to compensate in the highest degree through the efforts of the workers for the loss of working time. The goal which the workers set for themselves was not an easy one. They wanted to precede all others in introducing the experimental shortening of the work in the 01 Coal Concern with additional workers. This goal was reached not only by the workers in the 01 Coal Concern, during the fourth quarter of last year, by the workers of other coal concerns.

Another condition for a successful experimental operation with a shortened work week was to arrive already during the preparation at such results as would meet the goals set for introducing the experimental operation. This concerned first of all the daily average output, and the total output from the surface mines. The preparation lasted from the end of 1959, and during that time not only were the proposed methods legalized, but also some technico-organizational measures and possibilities of their application on a large scale and in various mines of the national coal industry were considered.

This very preparation had a decisive influence on the smooth changeover from the regular to the experimental shortened work week. This was evident in the results which had been achieved during the first quarter of 1960. The plan of the monthly output and average daily output was fulfilled by 103.9%, the plan of the labor productivity by 105.4%, the mining output by 105.8%, and the total output by 106.4%.

Another reason for the successful results achieved by the workers of South Moravian lignite mines was that the effectiveness of the technical and organizational measures was proved, and that the new methods consisted not only in utilizing the new machines, but also in controlling the organization of work, making a maximum use of the new, as well as of the formerly used, machines.

Systematic control of the results in connection with the efficiency of the proposed measures, as well as with regard to the fulfillment of all the technical and economic indicators of production in coal concerns, establishments, and working places, assisted in fulfillment and over-fulfillment of the planned goals. In view of the fact that not only the management, but also the workers participated in the above-mentioned control, it was possible to remove faults and difficulties which became obvious during the experimental operation.

The good results were further supported by the development of socialist competition. It was not a mere coincidence that exactly at the time of preparation for the experimental shortening of the work week the number of competitors increased to 70% of the total number of workers. At the same time there were 18 collectives which were competing for the title "Brigade of Socialist Work", and four of these collectives had already acquired this title.

Finally, a very important factor contributing to the good results was the fact that the whole development of the experimental shortening of the work week was under constant control of the Party and labor organizations, and that the results achieved in the coal concerns were systematically discussed by the Party and labor section authorities of the appropriate okreses or krajs.

At an extended meeting held by the technico-economic council of directors of the South Moravian lignite mines, while discussing the value of the experimental operation, some faults were indicated which still present an obstacle to reaching better results. This concerns especially overtime work; without its substantial reduction it will be quite impossible to create permanent conditions for the shortening of the work week.

It will be necessary to find some new means for reducing production costs and simultaneously to end the nonfulfillment of some indicators of production, especially of the average daily output per coal face and the average extension of coal face. All these problems were discussed by the workers. From now on the important thing will be to remove the faults by joint efforts and to overcome the difficulties in the same successful manner in which the output tasks were fulfilled.

EAST GERMANY

RETROSPECT AND OUTLOOK IN THE RAW MATERIALS AND BUILDING INDUSTRIES

[Following is the translation of an article (English version above) by Kurt Wagner in Standardisierung (Standardization) No 1, Berlin, January 1961, pages 1/1 - 1/2.]

Compared with 1959, the year 1960 brought a considerable increase of standardization tasks in the raw materials and building industries. Higher demands had to be made in regard to the quality of the projects submitted. Initial attempts to transfer the examination of projects from this office [Board of Standardization] to appropriate technical-scientific centers lead to a profitable exchange of experiences among planning authorities, central agencies, technical reporters and examiners. Their cooperative effort proved to be effective in the subsequent work as well.

While due recognition must be given to the achievements, the shortcomings should not be overlooked. Although leading politicians and economists have repeatedly pointed out the importance of standardization in the development of our economy, the necessary disciplined planning -- which has become a matter of course in the realization of production projects, for example -- has been neglected in the field of standardization. Even though the standardization planning division was incorporated in the plan "Neue Technik" (New Technology) as of 1961, the illusion that this project is second to production responsibilities and other tasks still prevails, even among leading economists. The fact that the coordinated effort in standardization leaves something to be desired is often excused by the shortage of personnel.

In the ZfS [Zentrale fur Standardisierung -- Bureau of Standardization] Photochemistry, standardization was inadequate, yet a specialized engineer was not hired until the fourth quarter.

In the VVB Mineral Oils, the head of ZfS went abroad for several weeks. The DIA (Deutscher In- und Aussenhandel -- German Internal and External Trade) division of the glass-ceramics plant authorized the chief of ZfS in VVB Glass to go to a foreign exhibition as stand attendant, without informing the VVB about it. The VVB Non-ferrous Metals does not even have the clerical personnel to provide a final copy of completed projects. That our future living standard depends on our efforts today is an accepted

fact; however, numerous branches of the economy still fail to realize that greater efficiency by means of standardization in the future is part of today's work. It must be admitted that this attitude does not prevail in branches like machine building, where standardization has been a tradition for decades. The general lack of perception, however, accounts for the inadequate preparation for 1961 and insufficient cooperation between the KDT [Kammer der Technik -- Chamber of Technology] and the socialist labor cooperative in the planning and introduction of standards. The ghost of indolence has not been entirely overcome yet; the battle has to be intensified and carried on.

In 1960 many important problems were solved in the industrial branches of mining and foundries. Over one half of our production in black metallurgy was standardized, and on several occasions recommendations of standardization agencies of socialist countries were found to be helpful. Dependence upon imports often accounts for the postponement of some highly necessary standards -- as for example in the steel pipe industry. In our economy standards have a purpose only if import and domestic production can guarantee a continuous and balanced supply. Standardization in the GDR must correspond to the conditions of socialist production, as well as to political realities. Frequently the attempts of the metallurgical industry to provide a useful assortment of kinds of steel and fabricated steel result in failure due to individual requirements, petitions for exceptions, and a lack of understanding of our economic realities. The plans for 1961 are to standardize the remaining brands and measurements, particularly of drawn steel in the second stage of manufacture, so that older and outdated overall lists, such as the SES list, will be replaced by a new list of standards.

In the battle against quantity rather than quality production, supplements for the manufacture of castings and forging items were standardized with the goal of economizing on materials. The simplification of material assortments in the fireproofing industry brought about economic advantages and an increase in labor productivity. The employment of copper stag -- as prescribed in standards -- instead of imported materials for wearproof linings saved foreign exchange and expenses and resulted in higher technical values.

The generally good cooperation between representatives of the metallurgical industry and this office was clouded through the inefficiency in the VVB Non-ferrous Metals. The shortcomings were recognized early and a plan was set up to cope with them. However, the measures were not carried out until the last quarter. Even if the backlog is partially caught up with at the end of the year, the disruption in the plans of our office are not eliminated.

The tardiness in submission of many projects at this time results in an accumulation of work which makes a thorough analysis of projects and efficient processing impossible.

In the industrial branches of coal, a part of coal and coke products were standardized, retail parts were made uniform, and considerable effort was put into standardizing the equipment. In our opinion, however, in spite of all the willingness for a combined effort to improve the quality of products and to formulate progressive quality specifications, there is still not enough being done. Delay in the work and the realization of plans must be fought more vigorously. In 1961 a high degree of standardization of products and further improvement and standardization of equipment must be achieved.

In the field of chemistry a large number of standards for products has been worked out. The standards include those for basic chemicals, buna rubber, and PVC [a plastic-like material], laboratory chemicals and pharmaceutical products, tires and tubes, artificial fiber and photographic material, textile auxiliary materials, varnish and paint, and even items like lighters and solvents for polishing wax. A particularly good performance was shown by the plants of electro-chemistry and plastic, the pharmaceutical industry, and varnish and paints.

Work was also taken up in international standardization in order to improve cooperation with other socialist states. In this industrial branch, however, standardization lacked the continuous leadership and control of the specialized division of the SPK [Sozialistische Plan Kommission -- Socialist Planning Commission]. As a result, success in individual fields depended on the initiative of the VVB concerned, and consequently in several plants shortcomings and considerable delays became unavoidable. Not until in the fourth quarter did leadership of the chemistry division of the SPK decide to set down measures for improvement of the work. It was too late, however, to eliminate the loss of tempo. Particularly the VVB's Chemical Fiber, Photo-chemistry and General Chemistry are in dire need of central guidance and assistance in order to overcome the weaknesses which have arisen.

In the glass-ceramics section, important strides towards standardization were made. In consequence the way has been opened towards the advantageous establishment of the assortment of items to be produced, partial automation and new technologies. Similar accomplishments could have been realized in glass manufacture, where the undertaking corresponded to that in ceramics, but, poor management, such as insufficiently strict leadership, caused considerable delay. For coordination among the socialist countries, important preliminary work within the framework of the RGW was carried out, in which our standards were laid down as the basis. In this branch of industry standardization will bring decisive advantages in the

mechanization and centralization of manufacture in 1961 and also better utilization of sorely needed available capacity.

In the building industry, important lessons and experiences on the construction sites led to a reform of standardization lessons. The creation of more standardization units, which inevitably require new building components, is no longer the key, but rather the utilization of existing standardized building components as the foundation of planning. The development of this industrial branch from a building trade to an industry has not yet been completed. Stubborn adherence to outdated directives and hesitation to adopt warranted standard and quality specifications on the part of builders must be overcome. Tolerance margins should be reduced tenfold if higher work productivity is to be facilitated. Although this process of development is progressing, it must be admitted that delays in realizing the plan could have been avoided through greater alacrity of personnel placement. Radical standardization, particularly when viewed in the light of the Seven-year Plan, will bear valuable consequences in relation to our building projects. Thanks to the directives of 1960, organized socialist cooperation is to be expected. The systematic and voluntary assistance of KDT engineers in standardization tasks could serve other engineering branches as an example. Already in 1960 a number of important problems was solved. If the new 1961 forms of organization become a reality, a great step forward in the radical standardization of the building industry can be predicted.

In communications and development of water resources some tasks were fulfilled, and new, more powerful central stations were opened, but it was not until 1960 that organized plans for extensive and purposeful work were created. In nuclear technology, on the other hand, even the formation of central stations may not be regarded as complete. Standards have already been determined for the water supply, filtering plants, building components in highway, hydro-electric and dam construction, but considerably greater achievements are necessary in 1961 in order to regard the progress of the above branches as important.

In the raw materials and construction industries, standardization is still relatively new and contrary to previous concepts and habits. Its success depends on a highly concentrated effort. It should not be overlooked, however, that even in these branches of industry socialist standardization has progressed considerably. This partially new method for the improvement of our production and increase of labor productivity requires the participation of all workers. The goal in 1961 is to involve the remaining disinterested forces in the work of progressive, radical standardization.

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EAST GERMANY

THE APPLICATION POSSIBILITIES OF AIRCRAFT POWER PLANTS IN THE PRODUCTION OF PEAK LOAD ELECTRIC POWER

[Following is the translation of an article by H. Trimbuch, B. S. Engr., in Deutsche Flugtechnik (German Aviation Technology), Vol V, No 5, Berlin, May 1961, pages 165-173.]

1. Introduction.

In the present situation of hectic development and industrial growth there is an ever increasing need for electric power. The construction of production facilities of this energy has, therefore, become a major task for industry. The methods of generating electric power, however, have changed during this century. While the AC generator remained as the most important means of production, a new power plant, namely the gas turbine, has emerged in recent years. However, the construction of a gas turbine requires even at this stage a high expenditure of time and development than, e.g., that of a diesel engine or a steam turbine. The application of gas turbine installations for the production of peak load electric power appears to be especially successful. It offers vis-a-vis steam power generators and their appertaining steam production facilities, water preparation and complex water and steam conduit networks, important advantages, such as

Smaller space requirements (about 35 to 50%),
Smaller fuel requirements (about 25 to 30%),
Smaller investment costs (about 60 to 80%),
Shorter waiting periods and lower costs
Faster starting from the cold state
Less energy consumption.

Among the disadvantages are:

Shorter life
Greater fuel costs for the gas turbine type.

Furthermore, since at this time there is no dependable design in existence, the required development time and construction delay would present an added disadvantage if and when there is an urgent need. In connection with the steadily increasing life and the ever

lengthening maintenance intervals of aircraft power plants, the idea of a different application (other than airplanes) arises to examine their usefullness in the production of electricity, especially since these power plants are completely developed and physically in existence. That this idea has real merit is attested to by the fact that several gas turbines are being used in industry in the West, and have already proved themselves. Since these power plants can be obtained from the mass production lines of the respective aircraft industry, their production costs are naturally relatively low, and their production feasible on short notice.

The concept of applying aircraft power plants to maximum production of electric power has been examined, since in the GDR there are presently in existence aircraft engine plants using mass production methods. This will now be explained in detail.

2. Historical Development of the Gas Turbine.

When early in the century the steam turbine proved itself as a power plant for the production of electric power, the principles of the gas turbine were simultaneously developed. Thus, e.g., the Swiss Prof. Dr. Stodola, in his text of many years earlier covering steam turbines, recognized the importance of gas turbines. In 1898 he added a chapter to his book, which to this day is considered a standard text, dealing with gas turbines. Previously the steam engine was the only means of obtaining electric power, and it presented great disadvantages, primarily the presence of pistons with their linear motion and the need to use steam boilers with their complex servicing requirements. The steam turbine, as a rotating machine, eliminated the piston, but still requires the steam boiler. The combustion engine eliminated the steam boiler, but retained the piston. The gas turbine requires neither piston nor steam boiler. Although other scientists, such as Stolz, Karawadin, Holzwarth, et al. also recognized the importance of the gas turbine, the development thereof remained in the experimental stage, while the steam turbine experienced an exceedingly rapid and successful development. This can probably be attributed to the fact that due to the earlier development of the steam engine steam boiler construction skills had been sufficiently developed to permit the production of large quantities of steam with adequate potentials of pressure and temperature. On the other hand, the production of large quantities of gas with correspondingly adequate temperature and pressure potentials offered greater obstacles for a longer period of time. The realization of a gas turbine faltered for a long time because the effectivity required in the compressor and the turbine for commercial processing could not be attained and a sufficiently complete combustion in the chamber achieved. Fuel adequate for absolute temperature

control prior to entering the turbine had not been developed, and the hydraulic losses of the overall process had not been reduced to a useful degree.

But the advantages, once recognized, caused the power plant manufacturers in the course of several decades to pursue the objective of developing gas turbines of a high degree of efficiency. For the last several years technology has been engaged in eliminating the gap between gas and steam turbines.

Several gas turbine cycles have been developed and put into practice over the last decades, in accordance with their intended use and the fuel used. The best results were obtained through the so-called "open"process. It has the great advantage of liberating directly into the atmosphere all exhaust gases. In the development of the gas turbines based on this principle, two major methods have been used. One lead to the power plant gas turbine, the other to the aircraft gas turbine. The first decisive success in both instances was achieved in 1939. A gas turbine power source of 4,000 kw was put into operation in Neuchatel, Switzerland, being of Swiss manufacture. The efficiency at the output coupling was experimentally fixed at 18%, with power output at 17 kilograms per kilowatt. In the same year the first turbo-jet aircraft was flown in Germany. This was a Heinkel development (Type He S 3b).

While the war had an extremely favorable effect on the development of the airplane gas turbine for military purposes, its effect on on the stationary power plant gas turbine was a retarding one. Nevertheless, it can be stated that after a maturing period between 1935 and 1945 the gas turbine has proved itself in a number of applications, and in others shows great promise. However, the aircraft gas turbine has shown the greatest progress. Given its use, not only in civil but also military aviation, hundreds of types of aircraft power plants have been developed in recent years, and hundreds of thousands were built, which proved their worth in many millions of flying hours.

This development was coupled to the fact that the piston engine no longer satisfied the demands of modern aviation, and the development of the aviation gas turbine became an unavoidable necessity. The stationary gas turbine, however, presented several economic advantages -- see above -- but no vital need. Therefore, the leadership of gas turbine manufacturing was taken over by those who had developed the aircraft engines. Only in this manner can it be understood that gas turbine aircraft engines of the most simple design are economically equivalent to power plants with a multitude of parts and complex design.

3. The Thermodynamic Problems of the Gas Turbine Process

The basic engineering principles for both types of gas turbines are identical. The production of a gas with useful pressure and temperature potential takes place within the gas turbine itself by means of a compressor and fuel combustion, and not, as in steam turbines, in a separate vessel. Thus, the greatest portion of the mechanical energy produced in the turbine is used to move the compressor, and only the smallest part of the energy can be converted to useful energy. This useful energy increases proportionally with the decrease in required compressor energy input. Thus, the compressor and turbine efficiency (Fig. 1) acquires the greatest importance. The power output in kw/kg of air flow rises with the product of the compression and expansion processes and with the turbine entrance temperature of the gas. (The Figure has been obtained from the Brown-Boveri Communications, Vol 44, No 4/5, pages 192, and shows the relationship of the foregoing parameters at an air intake temperature of 20°C for a single step gas turbine).

The gas turbine method only became a promising venture when its efficiency could be raised, so that a sufficiently large portion of the energy produced became available for utilization. The liberated part of the total energy rises proportionally with increasing working temperature of the turbine. Fig. 2 illustrates this graphically. It shows the relationship of thermal efficiency and the product of compressor and expansion process efficiencies ($\eta_c \cdot \eta_e$) as well as the ratio of turbine entrance to air intake temperatures, (T_4/T_1). To attain a favorable thermal efficiency it became necessary to raise the efficiency of the turbo-wheel pump motors. The ratio T_2/T_1 and, therefore, the increase in compressor compression, however, cannot be continued at will, because the turbine entrance temperature limits this increase. The limited heat resistance of turbine scoops and discs restricts the choice of temperatures. Thus the gas turbine faced a difficult problem at the very beginning of its development.

Two means of solution of this problem have been devised. In the stationary gas turbine it was attempted to achieve compression in consecutive steps with periodic cooling in between, and by combustion in steps with partial discharge after each step. This development followed the direction of the Carnot cycle. A further increase in efficiency can be achieved by the use of heat exchangers which transfer the exhaust gases of the turbine into the compressed air. This method makes the installation more economical but also much more complex.

In the development of aircraft engines this method was unfeasible due to weight and space considerations. It became necessary through massive research to solve the problems of flow type machinery

and to raise their efficiency, as well as to develop high temperature materials to permit raising the temperature of the cycle. In connection with this research the stepped compression of the aircraft type engine was raised appreciably vis-a-vis the stationary type. The large number of aircraft engines built and the stringent requirements of the aviation industry greatly accelerated these developments, so that aircraft engines today are noted for their simplified construction and advanced design, coupled with great reliability. The two developments require far less pressure than steam turbines. While steam turbines require 40, 64, 100 or even 140 kp/cm^2, the open gas turbine process requires between 5 and 15 kp/cm^2. This does not apply to entrance temperatures. The majority of steam turbines requires to this day about 530°C, and in some special cases 560°C, and recently even 600°C. The gas turbine, in order to be efficient works at considerably higher temperatures. In stationary turbines, e.g. Brown Boveri's, the temperatures range from 630 to 750°C. For airplane turbines these temperatures are significantly higher and in some cases have exceeded 1000°C.

4. Aircraft Engine Configuration

Fig. 3 shows a typical design of an aircraft engine. It shows a modern radial turbine engine with single shaft, very likely representing the state of the art of civil aviation engine design. The Figure shows a schematic of the TL Engine Pirna 014, developed in the GPR. While these engines present a high degree of efficiency, they are of simple construction, using small and compact parts, and require a minimum of construction time. The great advance in radial engine design is shown in Fig. 4. After years of research and development, it became possible to construct these small combustion chambers, which permit a maximum fuel combustion with the shortest possible travel, and to preserve a certain temperature distribution by proper mixing of fuel. The combustion chamber shown in Fig. 4 can be used for regular gasoline or diesel fuel. It is of lightweight construction, simple design, and allows for almost complete energy transformation from chemical to thermal. Pressure loss is minimal for the passing air; it permits highest specific power (load) per unit volume, and high specific air passage. Combustion is stabilized within the greatest possible ranges of temperature, pressure and velocity. There is good control, and heat resistance at the high temperatures and temperature variations over short periods of time. Hard sediments are avoided. This combustion chamber represents a sensible and favorable combination of a circular [ring] type and single combustion chamber. Combustion efficiency of 98 percent over a wide range of operation with a very small pressure loss of 2.5 percent is thus achieved. Fuel injection occurs in an even stream through 12 jets situated in a combustion chamber head,

centered individually. It has been shown during visual inspection that after hundreds of hours of operation there were no burning marks, cracks or coking which would have endangered the normal operation of the unit.

Compressor and turbine have both been constructed according to the latest design criteria. By means of a high ratio of pressure differentials between steps, only 12 compression steps for a total compression ratio of 7:1 were required, without impairing the efficiency of the compressor. The flow conditions in such high-powered axial compressors are naturally very complex and present great demands on the theoretical and experimental fluid flow technologies. However, the problems of the total compressor, which consists of a series coupling of many ring gates are incomparably greater. The theory of the compressor is at this time not sufficiently advanced to permit a completely reliable design procedure. Therefore, the development of the compressor will be a costly and lengthy project, and the completion of such a compressor, which can be operated without cracks or marks, is of paramount importance to the use of the whole power plant. The axial turbine with two steps, indicated in Fig. 3, which is firmly coupled to the compressor rotor and freely suspended, only serves to actuate the compressor, i.e., the gas leaves the turbine with a useful pressure and temperature potential. The gas thus produced by the compressor, combustion chamber and turbine can now be utilized for the propulsion of an aircraft, by its acceleration in a jet nozzle, or for turning a propeller or other rotating machinery by further conversion of the energy in additional turbine steps. In this way the turbo-engine becomes a turbo-prop engine. This form of turbo-engines is being used in the medium and low sub-sonic speed aircraft ranges. The figure shown is typical of turbo-prop engines of modern design, being a schematic representation of the British "Tine" motor by Rolls-Royce. Because of the increased number of steps and ensuing power take-off this engine has two shafts. The picture shows the first turbine step turns the nine-step high compression compressor, while the other three turbine steps or stages turn the six low compression compressors, and the screw via a gear system. The turbo-jet engine, therefore, serves for the production of gas energy, while the turbo-prop engine produces rotational energy.

The additional utilization of the pre-heated energy produced is also useful outside the aviation industry. Since aircraft engines are not operating continuously, but on an hourly basis, this might lead to the conclusion that their operational reliability is limited. This is not the case. On the contrary, better construction and fuel and prolonged development efforts will assure us of absolutely reliable and economic operation. Maintenance intervals and engine life are constantly on the increase, and maintenance intervals of 2,500 hours for aircraft operation have already been achieved.

5. Conclusions Based on Present Day Development State of Airplane Gas Turbine Engines.

Whenever short operational periods are involved, and where weight is significant, such as in movable installations, a gas turbine, patterned after the principles of the aircraft gas turbine will always prevail in the future. This means that in the future there will be aviation engines or lightweight construction engines based on the same principles used in the production of electric power, especially to cover peak demand periods.

When this concept was first proposed in the GDR two years ago, it was too new to be fully understood. The same idea, however, was contained in an article on the utilization of aviation gas turbines for industry and shipping in the British magazine Gas Oil Power as early as 1958. In connection with this, detailed data of a production series, originally developed for aircraft application, were given and a separate output turbine was proposed.

Recently, however, many articles have been published in the international press, stating that aircraft engines are being utilized in the production of electric power in the West. In this fashion the British 4,000-PS turbo-prop engine "Proteus," made by Bristol Siddeley, specially modified, was used last winter in the production of electric power in an unmanned power station in Dartmoor. It was plugged in by remote control to cover peak load demands. Also, the turbo-jet engine "Olympus" should have between 15,000 and 18,000 kw power output, and is also slated to be put into operation as an electric power source.

The gas output power of this engine is higher, however. It must be assumed that the temperature and rpm's for industrial use have been lowered in exchange for greater life. The same method is used in the US. Accordingly, the Pratt & Whitney engine model TL JT 3 C, which is used in the "Boeing 707" aircraft, and has proved itself extraordinarily reliable is said to be utilized in power production at the Cooper-Bessemer Corporation facilities. Construction of 18,000 engines of this model is the best proof of good design and reliability. Maintenance intervals for industrial operation are set at 8,000 hours, with actual down time of about four hours.

According to the latest information available, Pratt & Whitney has established a separate industrial engine plant which will handle all aircraft engine business of this type.

6. Survey of Application of GDR produced Machinery.

Two gas turbine development projects undertaken in the GDR have been brought to a successful conclusion:

a) The turbo-engine Pirna 014 (Fig. 7) during a government test run proved to have the required power output, guaranteed fuel con sumption, and reliability during operation and life.

b) The engine Pirna 017 (Fig. 8), which has many varied applications, and whose construction also followed light-weight design principles, also met basic specifications, and proved its adequacy during a series of continuous runs. Both engines are fundamentally different from each other, not only in output magnitudes, but also in their intended application which governed their development.

It will now be examined if and under what conditions these two light-weight engines which have reached mass production assembly lines can be utilized in the production of electric power.

The Pirna 014 Engine

If the Pirna 014 power plant is used without the propulsion jet it will be merely a gas producing device. The transformation of the useful energy contained in the gas into rotational energy for use in an AC generator requires a second turbine attachment, which would have to be specially built.

If the 014 power plant were to be used under identical operational conditions as it is for aircraft, a normal daily output of 11,000 hp maximum could be attained. This would offer the disadvantage of small maintenance intervals and short life due to the high thermal loading of the compressor motor turbine. However, if the operational temperature of this engine is fixed at a maximum 727°C, the useful energy output will drop to 8,500 hp, but this will raise the maintenance intervals and engine life, This will also greatly improve operational conditions of the attached output turbine, which will provide an entrance temperature for this turbine of 515°C, which is within the common and controllable working range. Under these condition time intervals between maintenance operations will be at least 1,000 hours, and engine life 5,000 to 7,000 hours. This means that if applied to peak load periods, the gas producer must be exchanged after one year, while the life of the engine is by no means over.

The most important and difficult part of a gas turbine, namely that which produces the useful hot gas, no longer needs to be developed in utilizing the Pirna 014 motor at proper and fixed operating values, but can presently be obtained from assembly lines. The only part still awaiting development is the use-turbine which already exists in a low pressure and temperature range. Contrary to the development risks incurred with the compressor and the time delay involved, as well as those of the combustion chamber, the design of this use-turbine, gas-coupled to the gas generator will require no great expenditures of time or materials. The size of

the use-turbine depends only on the coupling design and layout of the gas generator.

Thus the hot gases can be pumped from one, two or more engines into the use-turbine. The output reached at the generator terminals on a normal day (based on normal generator efficiency) should be about 6,250 kw using a Pirna 014 engine.

As stated above, two 014 motors can discharge their exhaust into a use-turbine, and this method will be chosen upon greater energy demand. If four motors are to be used, two use-turbines should be provided, and the AC generator will be driven from both ends, while the exciter must be placed next to the main aggregate.

Fig. 9 is a schematic representation of a gas turbine installation using two turbo-jets. This is merely intended as an approximation to illustrate such an installation. It would consist of the following:

a) Two gas generators (Pirna 014 engines without thrust jet)

b) Suction shaft with muffler

c) Intermediate housing to transfer hot gases to the use-turbine

d) One two-stage use-turbine with n 3,000 min^{-1}

e) One exhaust gas diffuser

f) One AC generator, including electrical control elements

g) Foundation frame and bearing supports

h) Switch gear

i) Pump station

j) Power plant building with equipment.

The space requirements for the aggregate can be reduced to 0.04 cu. m/kw and the input mass to 5.4 kg/kw for the above lay-out. This includes the AC generator. If only the apparatus without the generator is considered, the input mass further reduces to 1 kg/kw. In spite of this enormous saving in material and space, the thermal efficiency is no lower than equivalent installations of heavy machinery. It runs about 23 percent, i.e., the specific fuel consumption is about 0.370 kg/kwhr.

The Pirna Engine 017

The lightweight engine Pirna 017 offers some slight differences. This engine can only be compared, as far as its cycle goes, to a turbo-prop and not a turbo-jet engine (Fig. 10). A one-stage jet compressor transfers the air into a ring combustion chamber. A rotating injector adds the fuel there. The heat content of the combustion gases created is then transformed into mechanical work in a two-stage axial turbine. Part of this work is used to turn the compressor. The remaining energy can be used to turn a generator by means of a transmission gear, (Fig. 11). The continuous output proven on a test stand amounted to about 100 kw, and could be raised somewhat without great strain. The fuel consumption was about 0.820 kg/kwhr for the installation without heat transfer mechanism, and about 0.535 kg/kwhr with such a mechanism. The installation is not very demanding as regards fuel, waiting period, and service. It can be run with commercial fuel, such as kerosene, diesel oil, or gasoline. It is started with an automatic starter button. After the surge, which lasts about 20 seconds, the aggregate can be loaded. No human attendance is required. Inoperative periods are merely due to cleaning requirements of fuel and lubrication filters every 100 hours of operation. Overhaul is indicated after 1,000 hrs.

7. Conclusions

As regards load capacity, the 014 engine, coupled with a use-turbine can be usefully employed as a generator of electric power to cover periods of peak load. The Pirna 017 engine, however, due to its low capacity is better suited to provide emergency power.

Using the 014 engine, the advantages of a gas turbine over a steam power generator can be even improved for peak load generation with the following results:

a) Space requirements can be reduced to one quarter, or at least one-half, of the usual gas turbine installations.

b) The mass per installed kw (including generator), by using light-weight construction methods and a smaller number of stages of the turbo-wheel pump motor, as well as omission of intermediate coolers, heaters, and heat exchangers, can be reduced to one-third of that of the common gas turbines.

c) Investment costs, by utilizing the gas generator as mass-produced and the reduced space requirements for the overall and auxiliary equipment, can be lowered to 30 percent of the cost of a steam power plant.

d) The waiting period can be even further reduced, since the controller can be designed for a fully automatic switchover by the load distributor, and operating personnel can be further reduced.

e) The starting time can be reduced. This does not only depend on the power generator part, for which eight to ten minutes are reauired, but primarily on the excellence of design of the AC generator. The gas generators can be fully loaded from a cold state in about six minutes.

f) The actual consumption is also smaller, since gas generator power plants are independent of extraneous sources, as per their originally intended use.

Furthermore,

g) There are no development cost or risks involved.

h) The development risk for the use-turbine is minimal since design data have been fixed through existing and proven gas generators and no high operating temperatures are necessary for the other one.

i) Completion of the gas generators with a use-turbine can be accomplished on short notice; thus the machinery part would be complete.

j) Short assembly time of the machinery would mean short construction time.

k) There would be no down-time, due to repairs of exchanging gas generators being done during the daily non-operating period.

l) Easy and fast transportation of exchange power plants, as well as, if required, spare parts, due to the low weight of the gas generator.

m) Overhaul operations on an assembly line can be accomplished by utilizing existing aircraft engine facilities.

In order to provide proof of the statements made, a prototype installation is being built (See third cover sheet).

The prospect of utilizing aircraft engines not only for stationary installations, but also for mobile installation can be envisioned, taking advantage of the reduced space and weight requirements of these engines.

Fig 1. Output power (kw) P per air flow (kg) of a single step gas turbine vs. the product of thermodynamic efficiency of blast η_c and turbine η_e for various gas turbine entrance temperatures, at an air intake at 20°C.

Fig 2. Thermal efficiency η_{th} of a single-step turbine without air preheater vs. ratio of absolute temperature T_4 and T_1.

Fig 3. Turbo-jet Engine Pirna 014 (Schematic Representation).

Fig 4. Combustion Chamber of the Turbo-jet Engine Pirna 014.

Fig 5. [No caption]

Fig 6. Turbo-prop (air injection) engine, schematic representation.

Fig 7. TL Engine Pirna 014

1 Intake cap
2 Oil tank
3 Cable box
4 Equipment carrier
5 Fuel intake
6 Fuel pump
7 Control pressure transmitter
8 Command signal instrument
9 Band exhaust
10 Exhaust cap
11 Manual lever
12 Air defrost
13 Engine suspension
14 Fuel injection jet nozzle
15 Ignition Equipment
16 Measuring instrument for exhaust temperature
17 Propulsion jet
18 Turbine
19 Combustion chamber
20 Lap exit
21 Drainage vent
22 Lap magnet vent
23 Cabin air remover
24 Compressor
25 Defrost connector
26 Oil filter
27 Oil pump
28 Gear housing
29 Mounting suspension
30 Oil drainage
31 Starter generator

Fig 8. [No Caption]

Fig 9. 1) Gas generator 2) Diffusor 3) Turbine 4) Exhaust deflector 5) Turbo-generator

Fig 10. [No Caption]

Fig 11. 1) Gas exhaust 2) 017E 3) Air intake 4) Transmission gear 5) Starter motor 6) Coupling n = 25U/S 7) AC constant voltage generator 8) Oil pump 9) rpm counter 10) rpm regulator

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END